

**Background Document G:**  
**Monte Carlo Modeling Output**  
**Utah Chemical Agent Rule (UCAR)**

**May 1999**

## **BACKGROUND DOCUMENT G:**

### **MONTE CARLO MODELING OUTPUT**

Monte Carlo simulations were used to conduct the modeling to develop probabilistic-based land disposal restrictions (LDR) concentration-based standards for the proposed Utah Chemical Agent Rule (UCAR). The Crystal Ball 4.0 software program was used for these simulations. The results of this modeling are presented in this background document. Preamble Section XI contains additional information.

Crystal Ball uses a technique called Monte Carlo simulation to forecast the entire range of results most likely to occur in the situation defined by the parameters in the spreadsheet model. After the user defines the assumption cells (parameter distributions) and overall forecast cells (defining cut-off criteria and degree of certainty to be portrayed in the final output) in the computer spreadsheet model, the next step is to run the simulation. This process involves generating random numbers for the assumption variables (out of the distribution the user provides). As the simulation runs, the calculated forecast cells are added to a graphical display forecast. The end result of the simulation is a graphical distribution (frequency chart) of the total repeated runs of the calculations. Crystal Ball also provides descriptive statistics for a given forecast, which summarizes the results numerically.

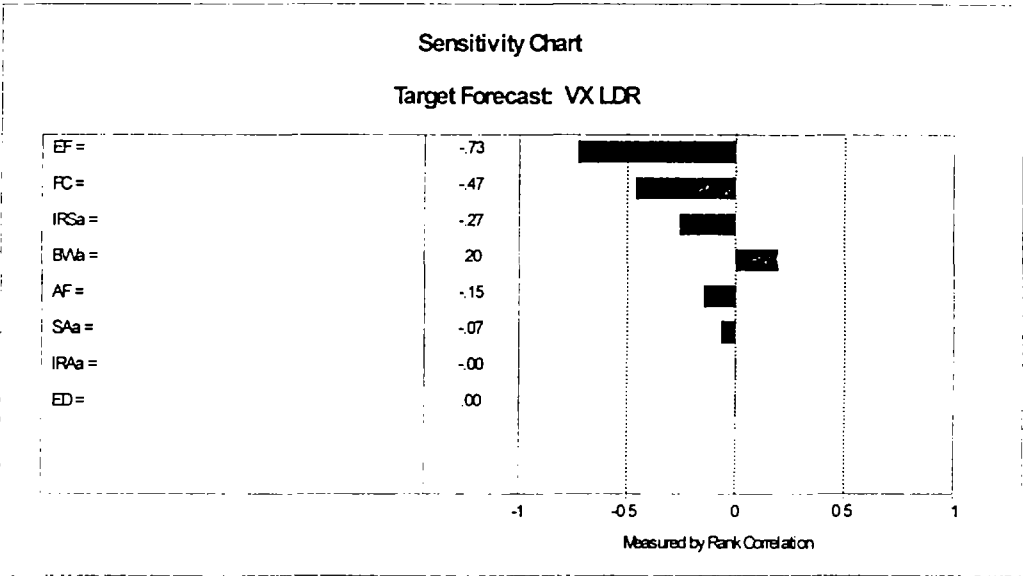
In addition to this process and output, the Crystal Ball software can provide other output, such as a graphical portrayal of the assumptions that were particularly "sensitive" (i.e., those in which changes from within the selected distribution contribute a relatively significant impact on the overall calculations). Also, graphic displays of the individual parameter assumptions used in the simulation can be portrayed. These outputs from the Crystal Ball 4.0 Version simulation that was run for the proposed Utah rulemaking are provided in this background document.

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**Crystal Ball Report**

Simulation started on 3/31/99 at 14:21:17

Simulation stopped on 3/31/99 at 14:22:00



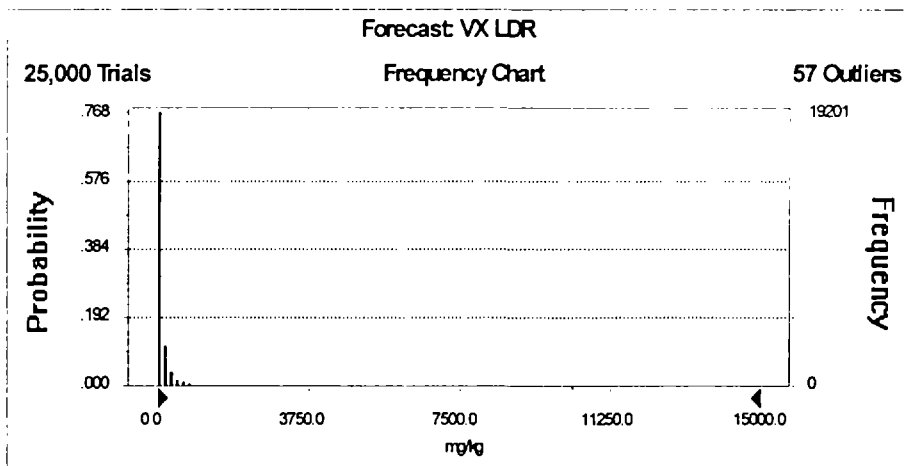
Forecast: VX LDR

Cell: D23

## Summary:

Display Range is from 0.0 to 15000.0 mg/kg  
 Entire Range is from 2.0 to 514046.5 mg/kg  
 After 25,000 Trials, the Std. Error of the Mean is 34.8

Statistics:	Value
Trials	25000
Mean	351.9
Median	64.0
Mode	---
Standard Deviation	5506.9
Variance	30325543.5
Skewness	65.38
Kurtosis	5,221.46
Coeff. of Variability	15.65
Range Minimum	2.0
Range Maximum	514046.5
Range Width	514044.5
Mean Std. Error	34.83



## Forecast: VX LDR (cont'd)

Cell: D23

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	2.0
5%	15.8
10%	20.5
15%	24.9
20%	29.3
25%	34.0
30%	38.8
35%	44.0
40%	50.0
45%	56.5
50%	64.0
55%	73.3
60%	84.1
65%	97.5
70%	114.5
75%	138.9
80%	175.2
85%	234.0
90%	355.1
95%	694.6
100%	514046.5

End of Forecast

### Assumptions

#### **Assumption: AF =**

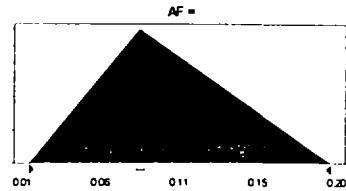
**Cell: D15**

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20

Mean value in simulation was 0.10



#### **Assumption: SAa =**

**Cell: D14**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.69



#### **Assumption: FC =**

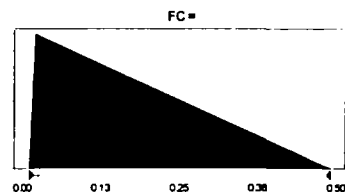
**Cell: D13**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50

Mean value in simulation was 0.17



#### **Assumption: IRSa =**

**Cell: D12**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	100.00
Maximum	216.00

Selected range is from 0.00 to 216.00

Mean value in simulation was 105.33



**Assumption: IRAa =**

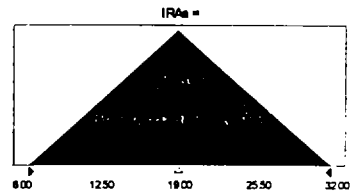
**Cell: D11**

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

Selected range is from 6.00 to 32.00

Mean value in simulation was 18.97



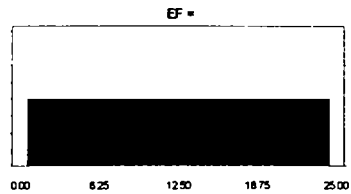
**Assumption: EF =**

**Cell: D9**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



**Assumption: ED =**

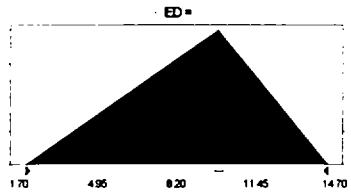
**Cell: D8**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80



**Assumption: BWa =**

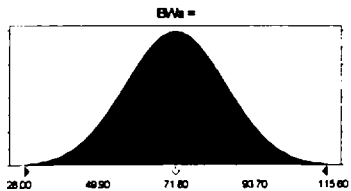
**Cell: D7**

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity

Mean value in simulation was 71.80



End of Assumptions



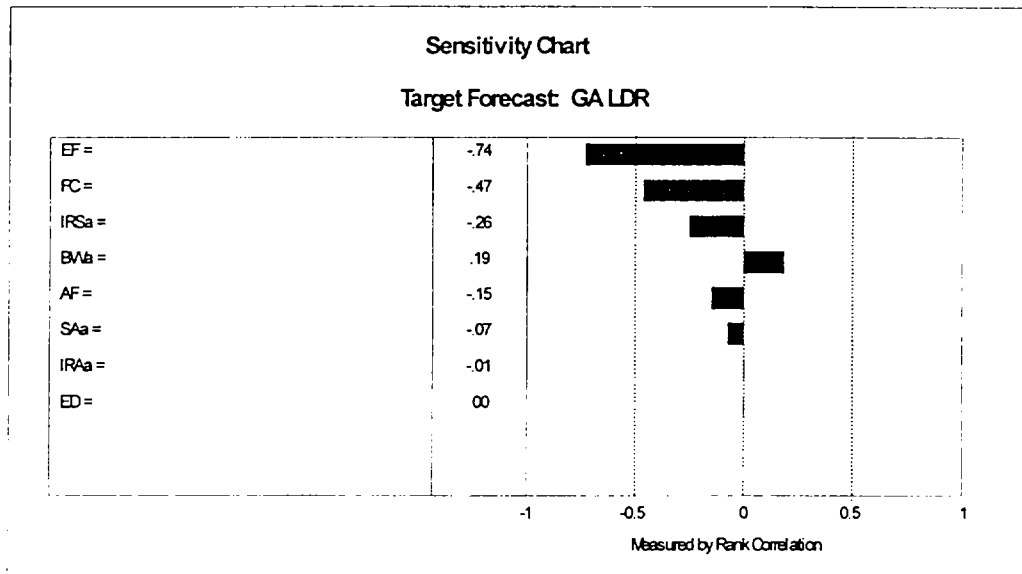
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# REPORT1

## Crystal Ball Report

Simulation started on 3/31/99 at 14:04:43

Simulation stopped on 3/31/99 at 14:05:24



# REPORT1

Forecast: GA LDR

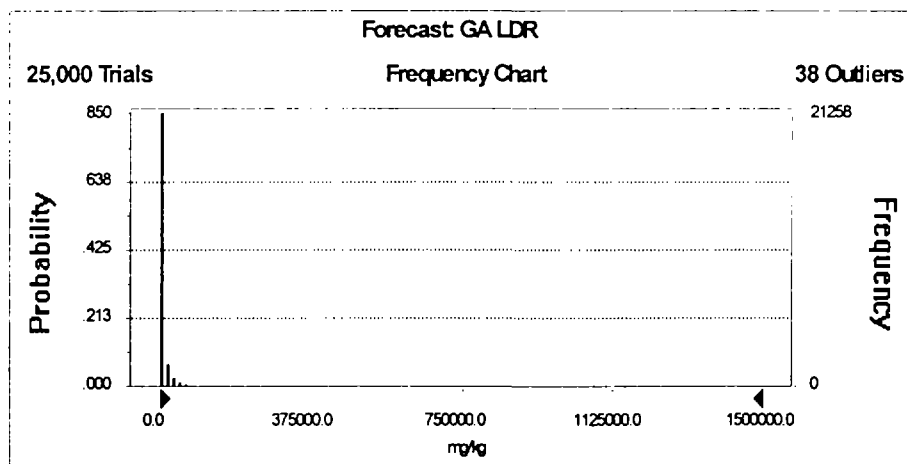
Cell: D23

## Summary:

Display Range is from 0.0 to 1500000.0 mg/kg  
Entire Range is from 170.5 to 61487081.2 mg/kg  
After 25,000 Trials, the Std. Error of the Mean is 3428.3

## Statistics:

	<u>Value</u>
Trials	25000
Mean	26087.5
Median	4174.2
Mode	---
Standard Deviation	542065.7
Variance	2.9E+11
Skewness	79.67
Kurtosis	7,793.81
Coeff. of Variability	20.78
Range Minimum	170.5
Range Maximum	61487081.2
Range Width	61486910.8
Mean Std. Error	3428.32



# REPORT1

Forecast: GA LDR (cont'd)

Cell: D23

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	170.5
5%	1065.5
10%	1374.9
15%	1647.4
20%	1947.4
25%	2246.9
30%	2544.7
35%	2880.3
40%	3253.8
45%	3686.6
50%	4174.2
55%	4768.5
60%	5450.6
65%	6321.4
70%	7402.9
75%	9008.5
80%	11282.2
85%	14973.2
90%	22686.4
95%	46007.7
100%	61487081.2

End of Forecast

## REPORT1

### Assumptions

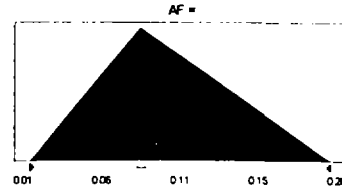
**Assumption: AF =**

**Cell: D15**

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20  
Mean value in simulation was 0.10



**Assumption: SAa =**

**Cell: D14**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00  
Mean value in simulation was 3,853.67



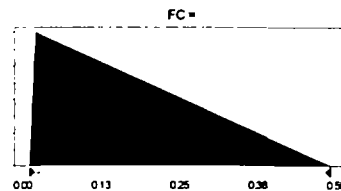
**Assumption: FC =**

**Cell: D13**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50  
Mean value in simulation was 0.17



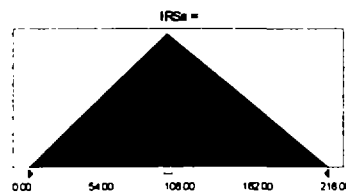
**Assumption: IRSa =**

**Cell: D12**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	100.00
Maximum	216.00

Selected range is from 0.00 to 216.00  
Mean value in simulation was 105.33



## REPORT1

**Assumption: IRAa =**

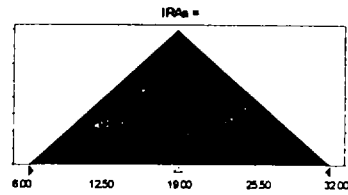
**Cell: D11**

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

Selected range is from 6.00 to 32.00

Mean value in simulation was 18.97



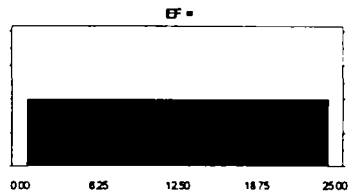
**Assumption: EF =**

**Cell: D9**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



**Assumption: ED =**

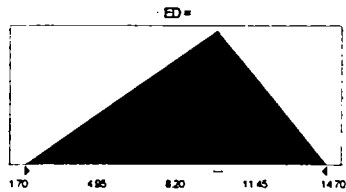
**Cell: D8**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80



**Assumption: BWa =**

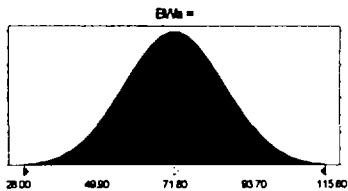
**Cell: D7**

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity

Mean value in simulation was 71.80



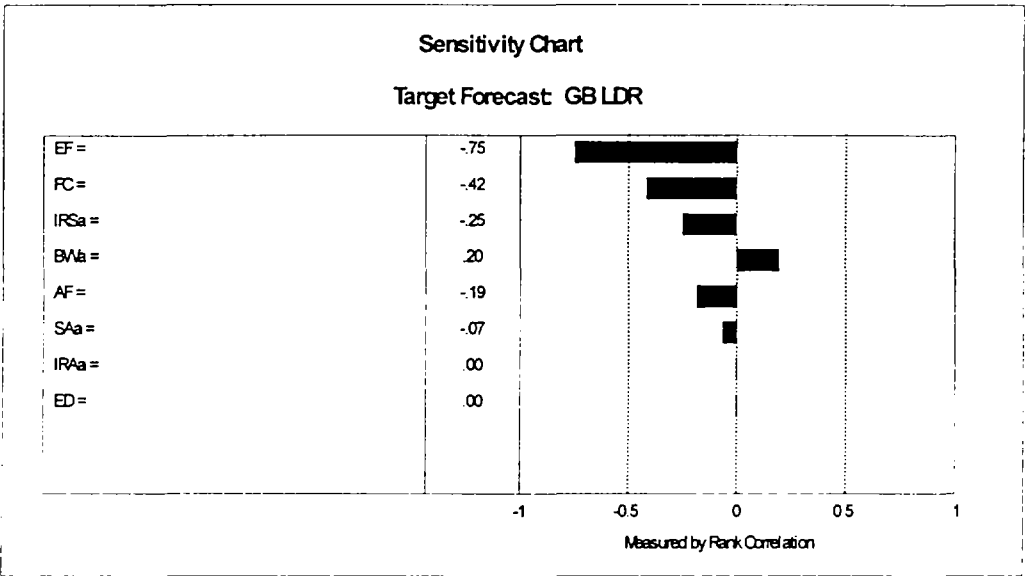
End of Assumptions

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**Crystal Ball Report**

Simulation started on 3/31/99 at 14:12:22

Simulation stopped on 3/31/99 at 14:13:03





Forecast: GB LDR

Cell: D23

## Summary:

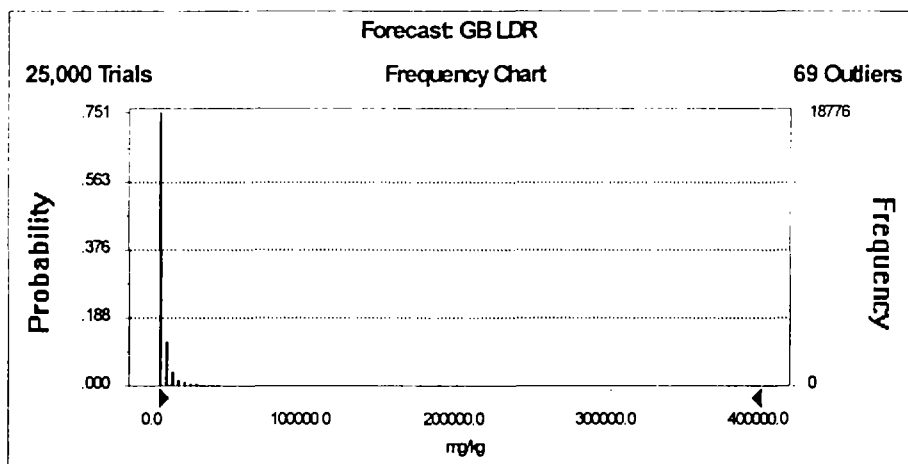
Display Range is from 0.0 to 400000.0 mg/kg

Entire Range is from 116.9 to 14022840.2 mg/kg

After 25,000 Trials, the Std. Error of the Mean is 853.8

## Statistics:

	<u>Value</u>
Trials	25000
Mean	9997.6
Median	1871.5
Mode	---
Standard Deviation	135000.5
Variance	18225140755.4
Skewness	62.45
Kurtosis	5,358.45
Coeff. of Variability	13.50
Range Minimum	116.9
Range Maximum	14022840.2
Range Width	14022723.3
Mean Std. Error	853.82



## Forecast: GB LDR (cont'd)

Cell: D23

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	116.9
5%	494.2
10%	638.2
15%	771.5
20%	899.7
25%	1025.9
30%	1161.6
35%	1308.0
40%	1479.9
45%	1664.6
50%	1871.5
55%	2126.5
60%	2416.9
65%	2797.7
70%	3312.7
75%	3978.4
80%	4966.1
85%	6671.8
90%	10196.1
95%	19958.7
100%	14022840.2

End of Forecast

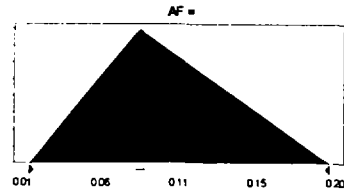
**Assumptions****Assumption: AF =****Cell: D15**

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20

Mean value in simulation was 0.10

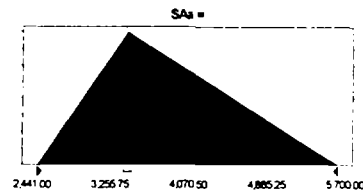
**Assumption: SAa =****Cell: D14**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.65

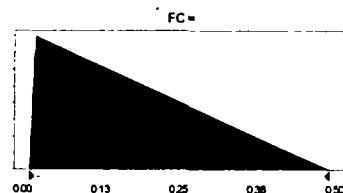
**Assumption: FC =****Cell: D13**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50

Mean value in simulation was 0.17

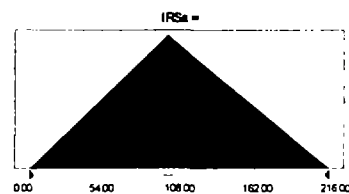
**Assumption: IRSa =****Cell: D12**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	100.00
Maximum	216.00

Selected range is from 0.00 to 216.00

Mean value in simulation was 105.33



**Assumption: IRAa =**

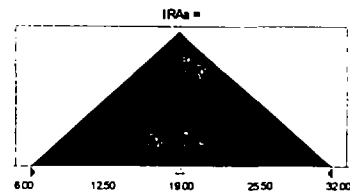
Cell: D11

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

Selected range is from 6.00 to 32.00

Mean value in simulation was 18.97

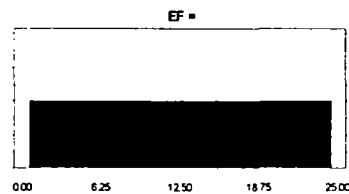
**Assumption: EF =**

Cell: D9

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50

**Assumption: ED =**

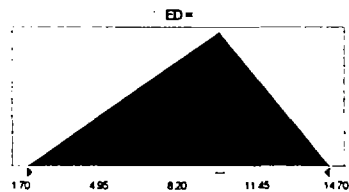
Cell: D8

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80

**Assumption: BWa =**

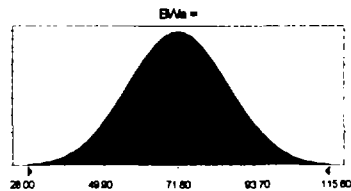
Cell: D7

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity

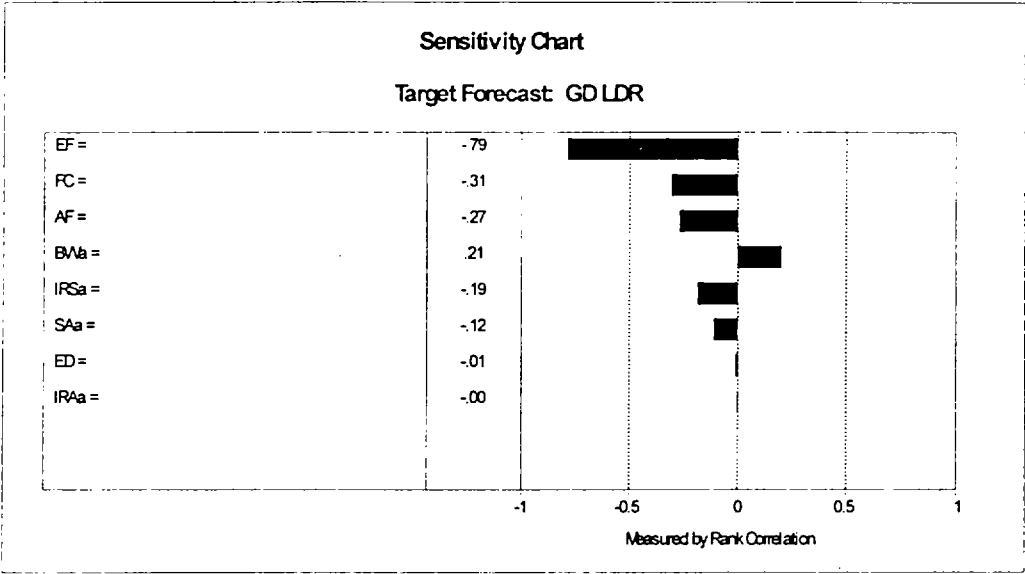
Mean value in simulation was 71.80



End of Assumptions

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**Crystal Ball Report**  
Simulation started on 3/31/99 at 14:15:41  
Simulation stopped on 3/31/99 at 14:16:23



Forecast: GD LDR

Cell: D23

## Summary:

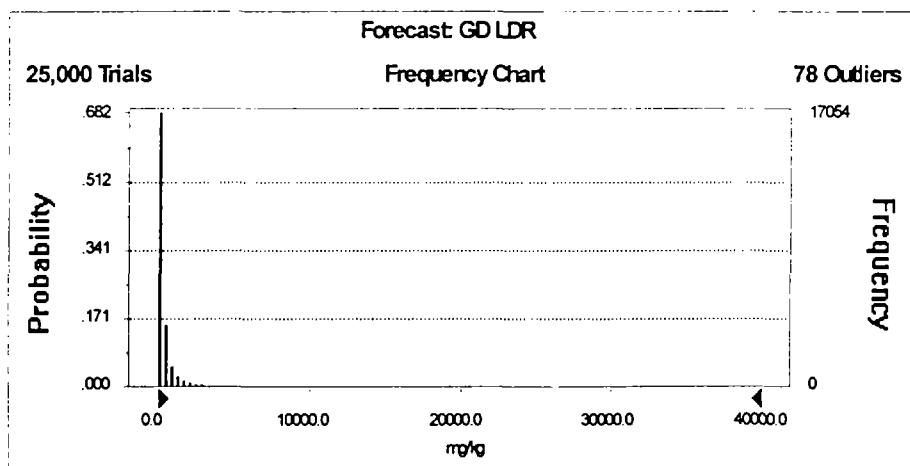
Display Range is from 0.0 to 40000.0 mg/kg

Entire Range is from 15.6 to 995339.2 mg/kg

After 25,000 Trials, the Std. Error of the Mean is 87.9

## Statistics:

	<u>Value</u>
Trials	25000
Mean	1215.8
Median	245.3
Mode	---
Standard Deviation	13892.6
Variance	193003727.8
Skewness	44.12
Kurtosis	2,418.32
Coeff. of Variability	11.43
Range Minimum	15.6
Range Maximum	995339.2
Range Width	995323.6
Mean Std. Error	87.86



Cell: D23

## Forecast: GD LDR (cont'd)

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	15.6
5%	75.6
10%	94.0
15%	109.4
20%	124.7
25%	139.6
30%	156.8
35%	175.1
40%	195.3
45%	217.4
50%	245.3
55%	276.7
60%	314.5
65%	361.9
70%	424.7
75%	509.8
80%	638.5
85%	856.0
90%	1275.9
95%	2543.5
100%	995339.2

End of Forecast

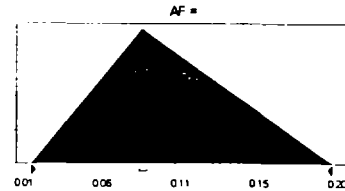


**Assumptions****Assumption: AF =****Cell: D15**

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20  
Mean value in simulation was 0.10

**Assumption: SAa =****Cell: D14**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,520.00
Maximum	5,700.00

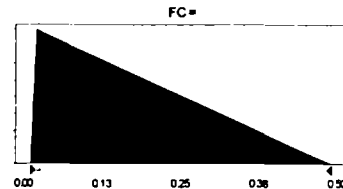
Selected range is from 2,441.00 to 5,700.00  
Mean value in simulation was 3,887.00

**Assumption: FC =****Cell: D13**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50  
Mean value in simulation was 0.17

**Assumption: IRSa =****Cell: D12**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	100.00
Maximum	216.00

Selected range is from 0.00 to 216.00  
Mean value in simulation was 105.33

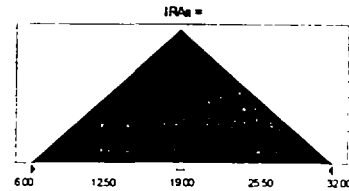


**Assumption: IRAa =****Cell: D11**

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

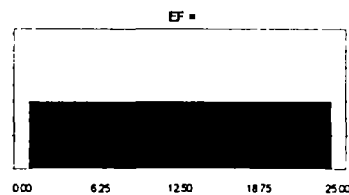
Selected range is from 6.00 to 32.00  
 Mean value in simulation was 18.97

**Assumption: EF =****Cell: D9**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50

**Assumption: ED =****Cell: D8**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70  
 Mean value in simulation was 8.80

**Assumption: BWa =****Cell: D7**

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

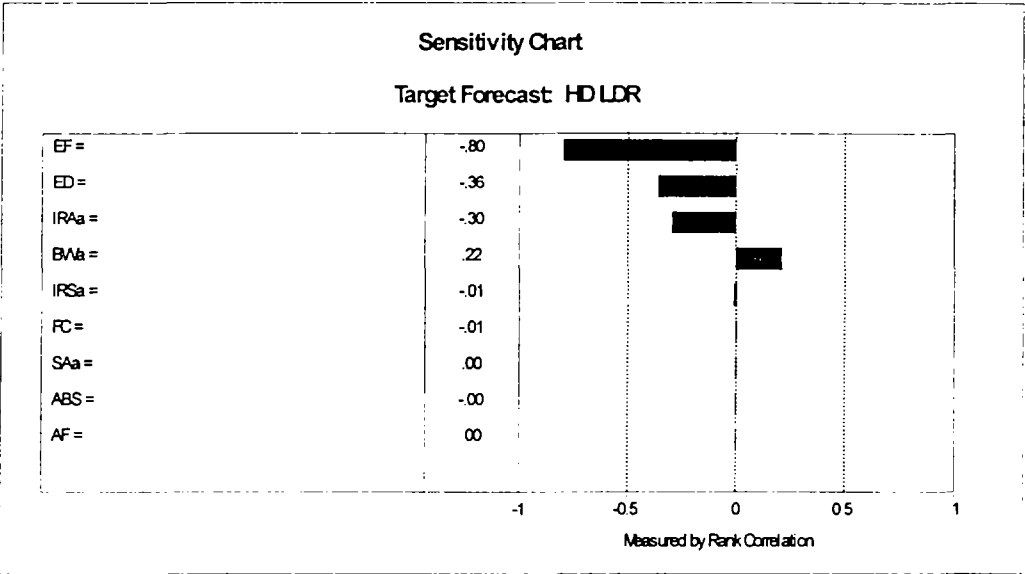
Selected range is from -Infinity to +Infinity  
 Mean value in simulation was 71.80



End of Assumptions

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**Crystal Ball Report**  
Simulation started on 3/31/99 at 14:17:25  
Simulation stopped on 3/31/99 at 14:18:09



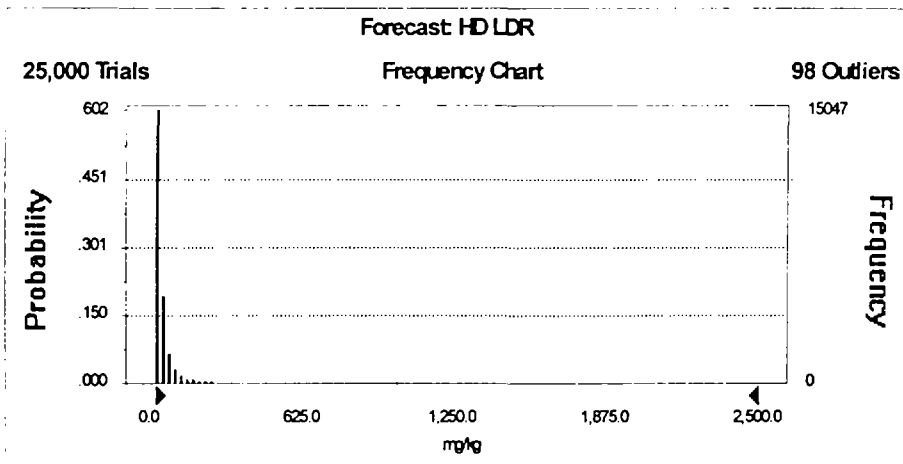
Forecast: HD LDR

Cell: D21

Summary:

Display Range is from 0.0 to 2,500.0 mg/kg  
 Entire Range is from 1.8 to 64,255.9 mg/kg  
 After 25,000 Trials, the Std. Error of the Mean is 5.6

Statistics:	Value
Trials	25000
Mean	90.3
Median	19.4
Mode	---
Standard Deviation	890.4
Variance	792,739.4
Skewness	43.94
Kurtosis	2,513.83
Coeff. of Variability	9.86
Range Minimum	1.8
Range Maximum	64,255.9
Range Width	64,254.1
Mean Std. Error	5.63



Forecast: HD LDR (cont'd)

Cell: D21

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	1.8
5%	6.2
10%	7.5
15%	8.6
20%	9.9
25%	11.0
30%	12.4
35%	13.8
40%	15.4
45%	17.3
50%	19.4
55%	21.8
60%	24.9
65%	28.7
70%	33.7
75%	40.7
80%	50.9
85%	68.5
90%	103.3
95%	207.7
100%	64,255.9

End of Forecast

### Assumptions

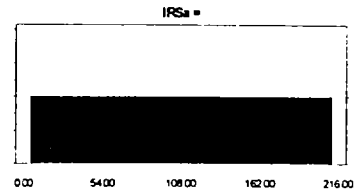
#### Assumption: IRSa =

Cell: D12

Uniform distribution with parameters:

Minimum	0.00
Maximum	216.00

Mean value in simulation was 108.00



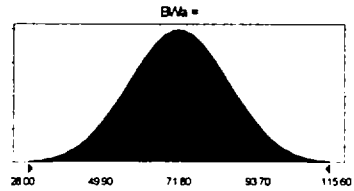
#### Assumption: BWa =

Cell: D7

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



#### Assumption: ED =

Cell: D8

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70  
Mean value in simulation was 8.80



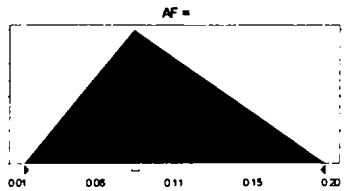
#### Assumption: AF =

Cell: D15

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20  
Mean value in simulation was 0.10



**Assumption: IRAa =**

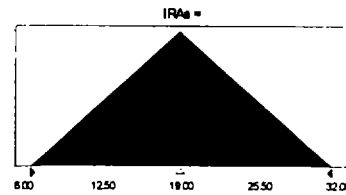
Cell: D11

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

Selected range is from 6.00 to 32.00

Mean value in simulation was 18.97



**Assumption: FC =**

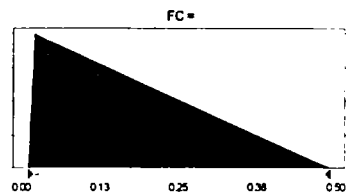
Cell: D13

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50

Mean value in simulation was 0.17



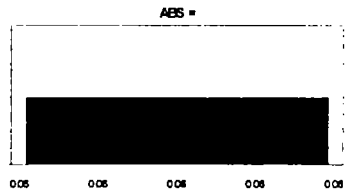
**Assumption: ABS =**

Cell: D16

Uniform distribution with parameters:

Minimum	0.06
Maximum	0.06

Mean value in simulation was 0.06



**Assumption: SAa =**

Cell: D14

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.65





Assumption: EF =

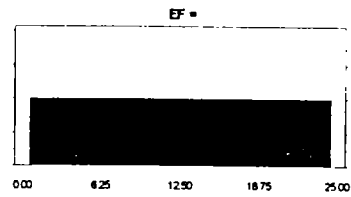
Cell: D9

Uniform distribution with parameters:

Minimum 0.00

Maximum 25.00

Mean value in simulation was 12.50

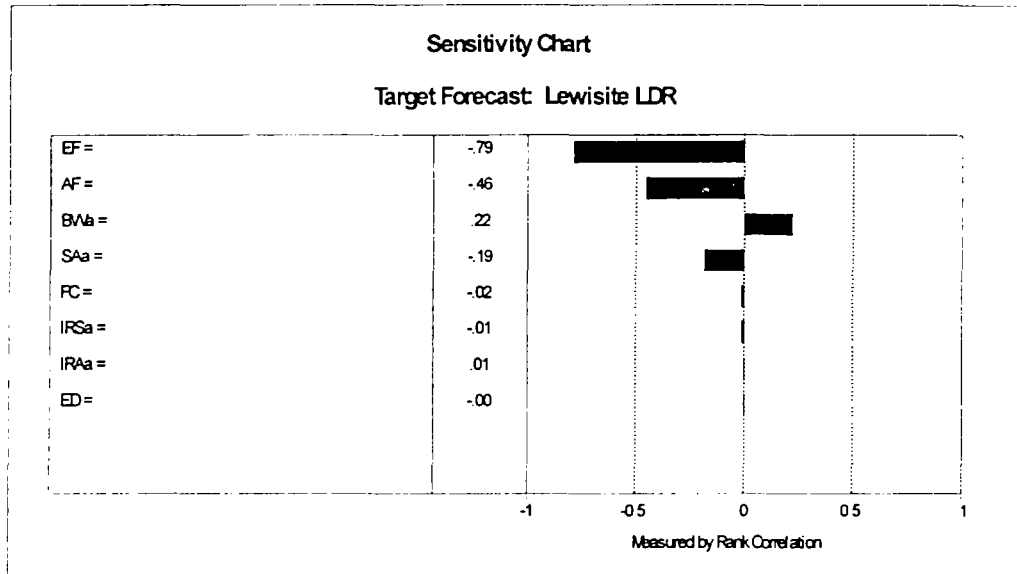


End of Assumptions

### Crystal Ball Report

Simulation started on 3/31/99 at 14:19:21

Simulation stopped on 3/31/99 at 14:20:03



Forecast: Lewisite LDR

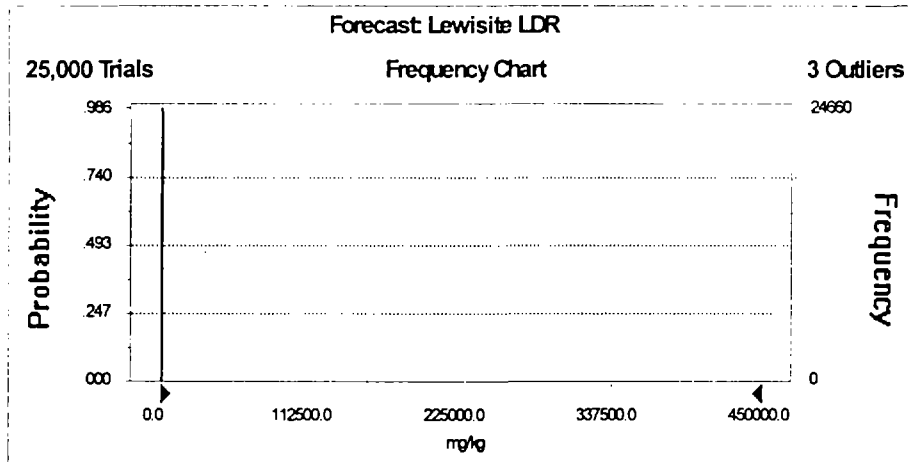
Cell: D24

Summary:

Display Range is from 0.0 to 450000.0 mg/kg  
 Entire Range is from 8.8 to 25500099.9 mg/kg  
 After 25,000 Trials, the Std. Error of the Mean is 1020.7

Statistics:

	<u>Value</u>
Trials	25000
Mean	1569.7
Median	112.8
Mode	---
Standard Deviation	161380.3
Variance	26043590173.9
Skewness	0.00
Kurtosis	+Infinity
Coeff. of Variability	102.81
Range Minimum	8.8
Range Maximum	25500099.9
Range Width	25500091.2
Mean Std. Error	1020.66



Forecast: Lewisite LDR (cont'd)

Cell: D24

Percentiles:

<u>Percentile</u>	<u>mg/kg</u>
0%	8.8
5%	34.4
10%	42.9
15%	50.0
20%	57.1
25%	64.3
30%	72.2
35%	80.7
40%	90.4
45%	100.2
50%	112.8
55%	126.8
60%	145.0
65%	168.5
70%	198.6
75%	241.8
80%	304.7
85%	408.6
90%	611.6
95%	1230.0
100%	25500099.9

End of Forecast

### Assumptions

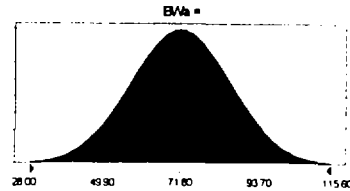
#### **Assumption: BWa =**

Cell: D8

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



#### **Assumption: ED =**

Cell: D9

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70  
Mean value in simulation was 8.80



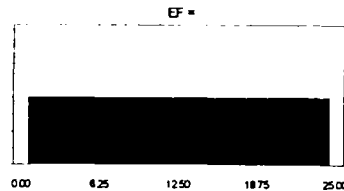
#### **Assumption: EF =**

Cell: D10

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



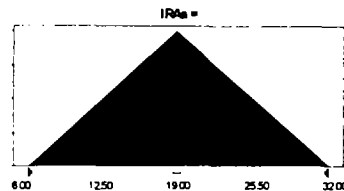
#### **Assumption: IRAa =**

Cell: D12

Triangular distribution with parameters:

Minimum	6.00
Likeliest	18.90
Maximum	32.00

Selected range is from 6.00 to 32.00  
Mean value in simulation was 18.97



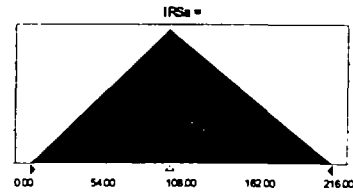
**Assumption: IRSa =**

**Cell: D13**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	100.00
Maximum	216.00

Selected range is from 0.00 to 216.00  
Mean value in simulation was 105.33



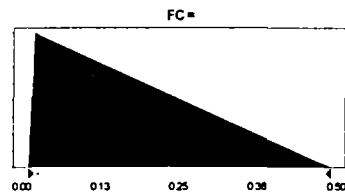
**Assumption: FC =**

**Cell: D14**

Triangular distribution with parameters:

Minimum	0.00
Likeliest	0.01
Maximum	0.50

Selected range is from 0.00 to 0.50  
Mean value in simulation was 0.17



**Assumption: SAa =**

**Cell: D15**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00  
Mean value in simulation was 3,853.65



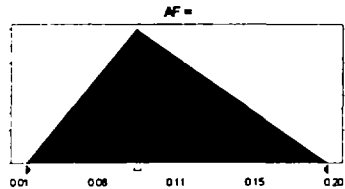
**Assumption: AF =**

**Cell: D16**

Triangular distribution with parameters:

Minimum	0.01
Likeliest	0.08
Maximum	0.20

Selected range is from 0.01 to 0.20  
Mean value in simulation was 0.10



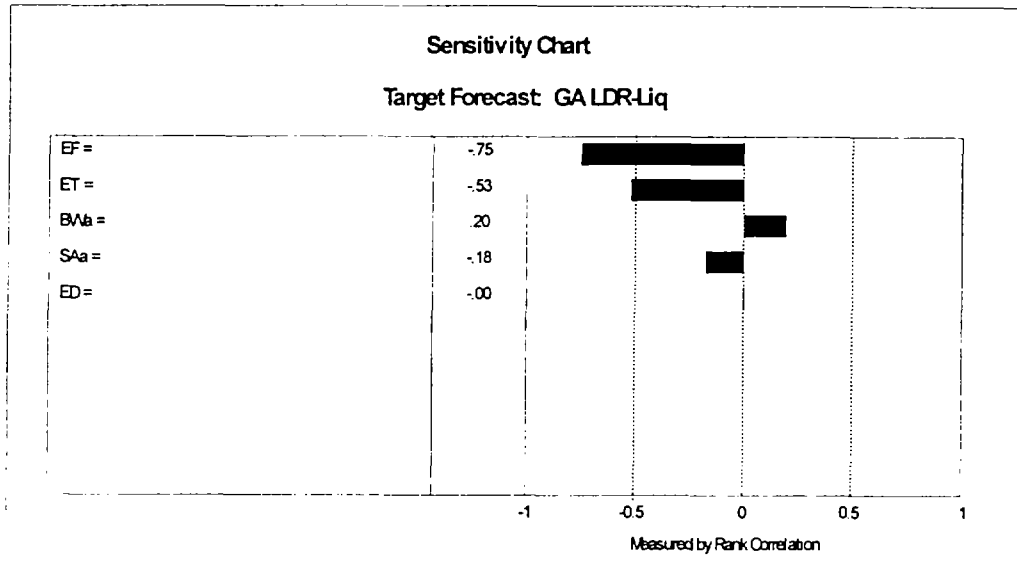
End of Assumptions

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### Crystal Ball Report

Simulation started on 2/10/99 at 16:47:17

Simulation stopped on 2/10/99 at 16:47:52





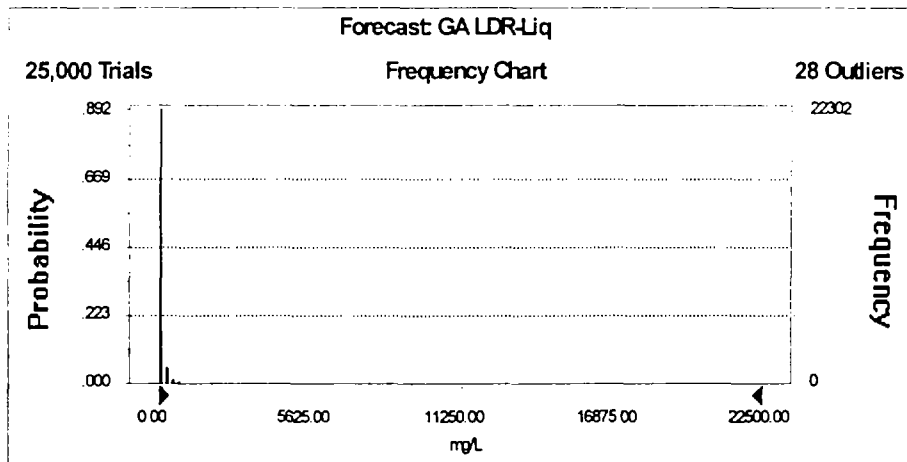
Forecast: GA LDR-Liq

Cell: C23

## Summary:

Display Range is from 0.00 to 17500.00 mg/L  
 Entire Range is from 3.51 to 692211.88 mg/L  
 After 25,000 Trials, the Std. Error of the Mean is 40.22

Statistics:	Value
Trials	25000
Mean	281.35
Median	43.39
Mode	---
Standard Deviation	6359.19
Variance	40439351.48
Skewness	77.25
Kurtosis	7,121.49
Coeff. of Variability	22.60
Range Minimum	3.51
Range Maximum	692211.88
Range Width	692208.37
Mean Std. Error	40.22



Forecast: GA LDR-Liq (cont'd)

Cell: C23

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	3.51
5%	12.02
10%	15.10
15%	18.00
20%	20.73
25%	23.56
30%	26.61
35%	30.05
40%	33.86
45%	38.42
50%	43.39
55%	49.30
60%	56.79
65%	65.86
70%	78.32
75%	94.39
80%	117.88
85%	158.06
90%	235.72
95%	474.16
100%	692211.88

End of Forecast

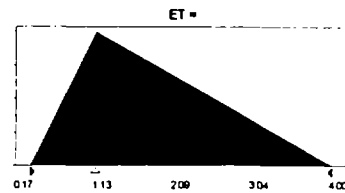
Assumptions**Assumption: ET =****Cell: C7**

Triangular distribution with parameters:

Minimum	0.17
Likeliest	1.00
Maximum	4.00

Selected range is from 0.17 to 4.00

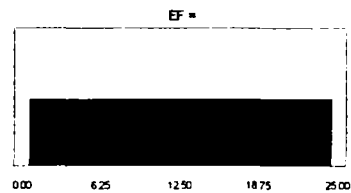
Mean value in simulation was 1.72

**Assumption: EF =****Cell: C8**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50

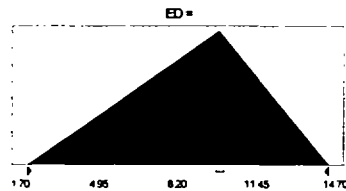
**Assumption: ED =****Cell: C9**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80

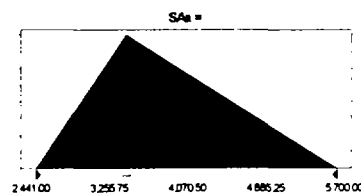
**Assumption: SAa =****Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.69



Assumption: BWa =

Cell: C13

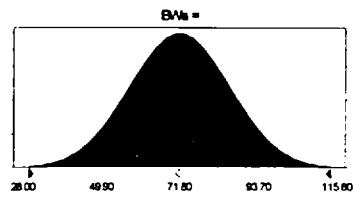
Normal distribution with parameters:

Mean 71.80

Standard Dev. 14.60

Selected range is from -Infinity to +Infinity

Mean value in simulation was 71.80



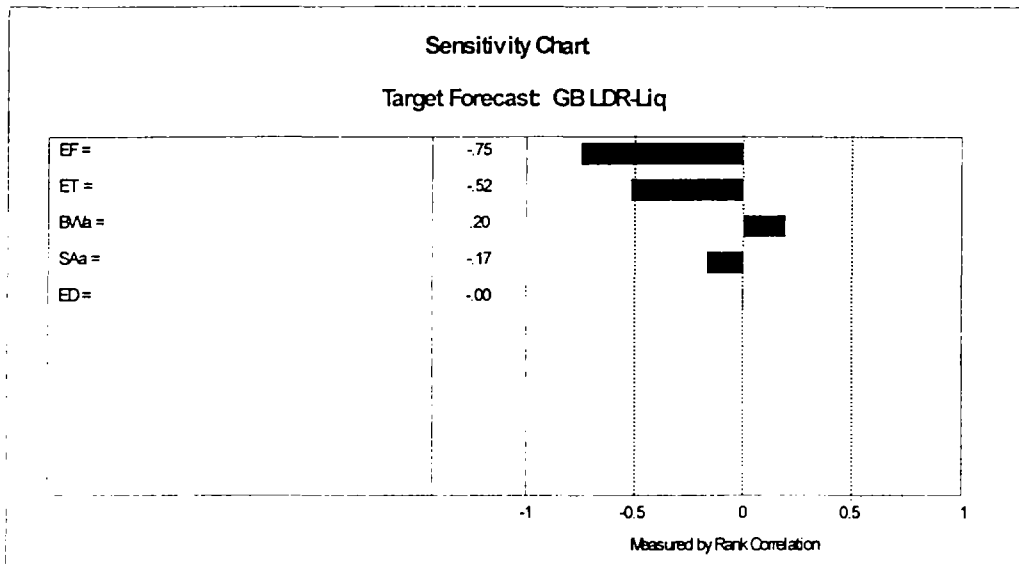
End of Assumptions

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### Crystal Ball Report

Simulation started on 2/10/99 at 16:44:23

Simulation stopped on 2/10/99 at 16:45:06



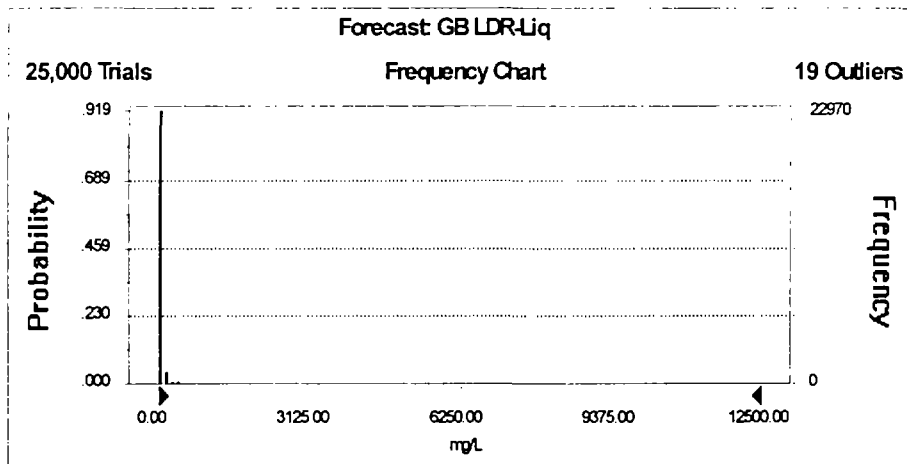
Forecast: GB LDR-Liq

Cell: C23

## Summary:

Display Range is from 0.00 to 10000.00 mg/L  
 Entire Range is from 1.08 to 334498.32 mg/L  
 After 25,000 Trials, the Std. Error of the Mean is 21.61

Statistics:	Value
Trials	25000
Mean	129.42
Median	18.31
Mode	---
Standard Deviation	3417.36
Variance	11678374.86
Skewness	76.82
Kurtosis	6,705.92
Coeff. of Variability	26.40
Range Minimum	1.08
Range Maximum	334498.32
Range Width	334497.25
Mean Std. Error	21.61



Forecast: GB LDR-Liq (cont'd)

Cell: C23

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	1.08
5%	5.05
10%	6.33
15%	7.58
20%	8.72
25%	10.00
30%	11.30
35%	12.69
40%	14.31
45%	16.19
50%	18.31
55%	20.79
60%	23.88
65%	27.81
70%	32.78
75%	39.74
80%	49.93
85%	66.60
90%	99.82
95%	201.39
100%	334498.32

End of Forecast

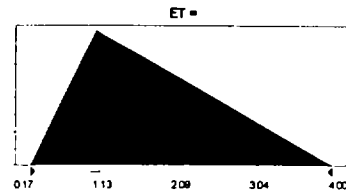


Assumptions**Assumption: ET =****Cell: C7**

Triangular distribution with parameters:

Minimum	0.17
Likeliest	1.00
Maximum	4.00

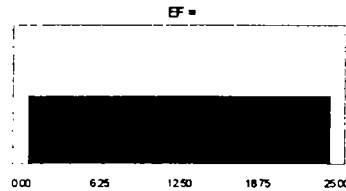
Selected range is from 0.17 to 4.00  
Mean value in simulation was 1.72

**Assumption: EF =****Cell: C8**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

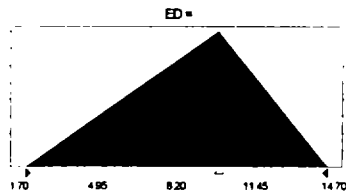
Mean value in simulation was 12.50

**Assumption: ED =****Cell: C9**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

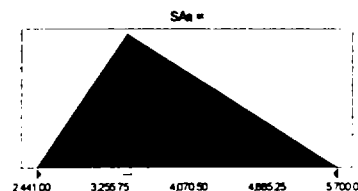
Selected range is from 1.70 to 14.70  
Mean value in simulation was 8.80

**Assumption: SAa =****Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00  
Mean value in simulation was 3,853.66



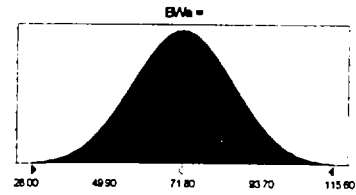
Assumption: BWa =

Cell: C13

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



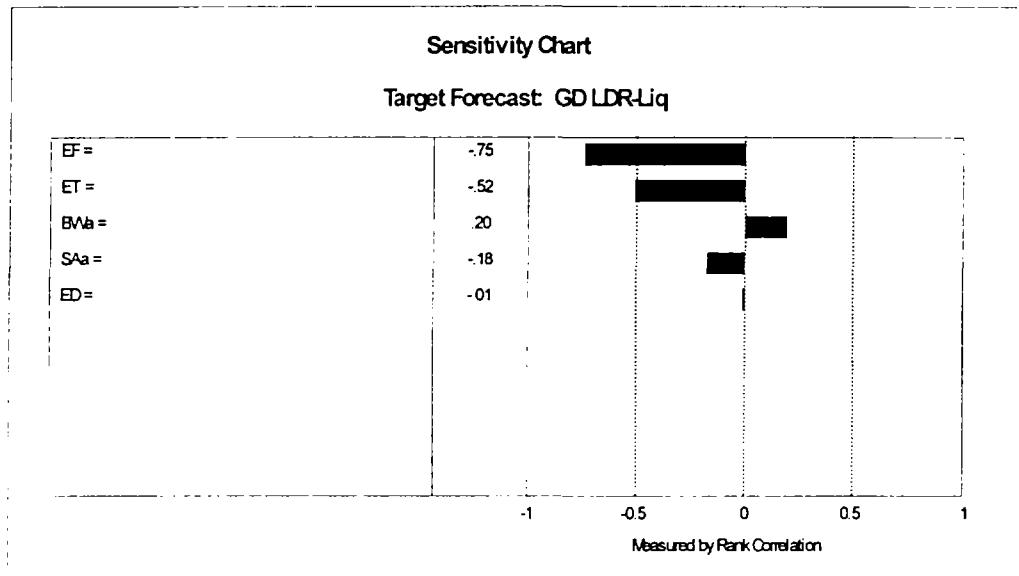
End of Assumptions

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### Crystal Ball Report

Simulation started on 2/10/99 at 16:49:20

Simulation stopped on 2/10/99 at 16:49:55



Forecast: GD LDR-Liq

Cell: C23

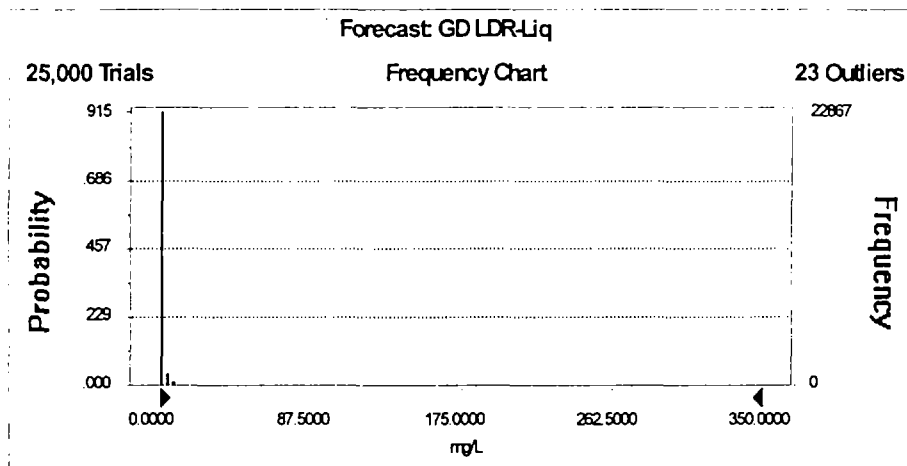
## Summary:

Display Range is from 0.0000 to 350.0000 mg/L

Entire Range is from 0.0419 to 19023.0119 mg/L

After 25,000 Trials, the Std. Error of the Mean is 0.8406

Statistics:	Value
Trials	25000
Mean	3.9408
Median	0.5442
Mode	---
Standard Deviation	132.9164
Variance	17666.7744
Skewness	0.00
Kurtosis	+Infinity
Coeff. of Variability	33.73
Range Minimum	0.0419
Range Maximum	19023.0119
Range Width	19022.9699
Mean Std. Error	0.8406



Forecast: GD LDR-Liq (cont'd)

Cell: C23

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	0.0419
5%	0.1528
10%	0.1912
15%	0.2275
20%	0.2634
25%	0.2997
30%	0.3406
35%	0.3830
40%	0.4311
45%	0.4847
50%	0.5442
55%	0.6215
60%	0.7110
65%	0.8271
70%	0.9799
75%	1.1824
80%	1.5107
85%	1.9913
90%	2.9950
95%	6.0656
100%	19023.0119

End of Forecast

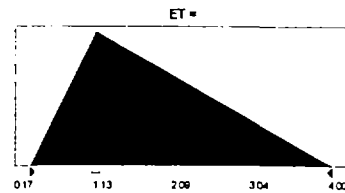
Assumptions**Assumption: ET =****Cell: C7**

Triangular distribution with parameters:

Minimum	0.17
Likeliest	1.00
Maximum	4.00

Selected range is from 0.17 to 4.00

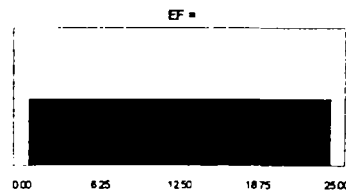
Mean value in simulation was 1.72

**Assumption: EF =****Cell: C8**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50

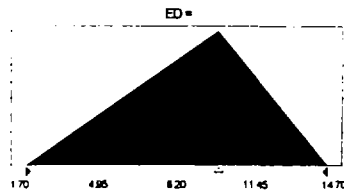
**Assumption: ED =****Cell: C9**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80

**Assumption: SAa =****Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.68



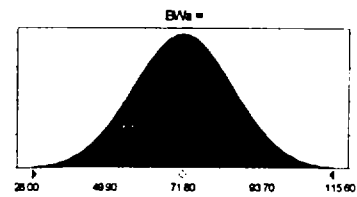
Assumption: BWa =

Cell: C13

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



End of Assumptions

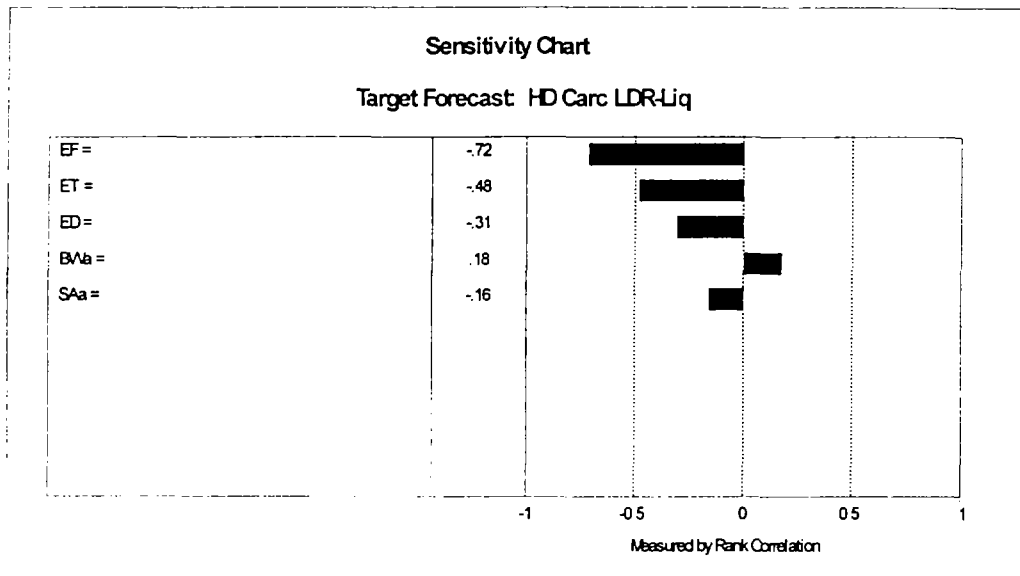


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### Crystal Ball Report

Simulation started on 2/10/99 at 16:54:48

Simulation stopped on 2/10/99 at 16:55:23



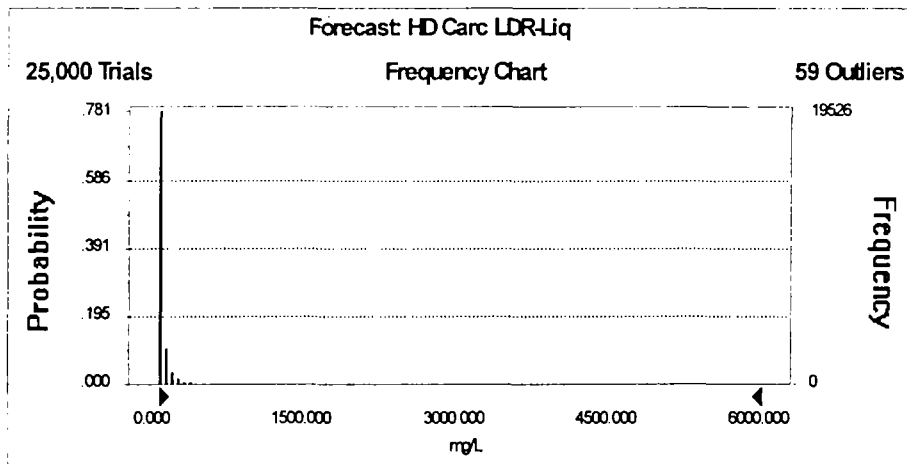
Forecast: HD Carc LDR-Liq

Cell: C27

Summary:

Display Range is from 0.000 to 25000.000 mg/L  
 Entire Range is from 1.364 to 1392078.608 mg/L  
 After 25,000 Trials, the Std. Error of the Mean is 56.900

Statistics:	Value
Trials	25000
Mean	186.434
Median	22.866
Mode	---
Standard Deviation	8996.691
Variance	80940445.585
Skewness	0.00
Kurtosis	+Infinity
Coeff. of Variability	48.26
Range Minimum	1.364
Range Maximum	1392078.608
Range Width	1392077.245
Mean Std. Error	56.900



Forecast: HD Carc LDR-Liq (cont'd)

Cell: C27

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	1.364
5%	5.621
10%	7.284
15%	8.776
20%	10.287
25%	11.821
30%	13.518
35%	15.400
40%	17.520
45%	20.015
50%	22.866
55%	26.321
60%	30.780
65%	35.974
70%	42.767
75%	52.254
80%	65.510
85%	87.417
90%	130.119
95%	254.505
100%	1392078.608

End of Forecast

### Assumptions

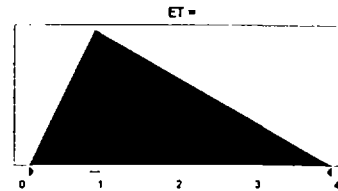
**Assumption: ET =**

**Cell: C8**

Triangular distribution with parameters:

Minimum	0
Likeliest	1
Maximum	4

Selected range is from 0 to 4  
Mean value in simulation was 2



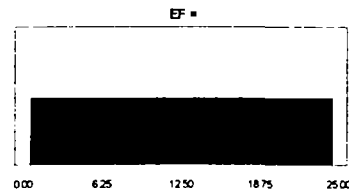
**Assumption: EF =**

**Cell: C9**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



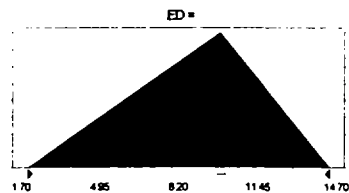
**Assumption: ED =**

**Cell: C10**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70  
Mean value in simulation was 8.80



**Assumption: SAa =**

**Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00  
Mean value in simulation was 3,853.66



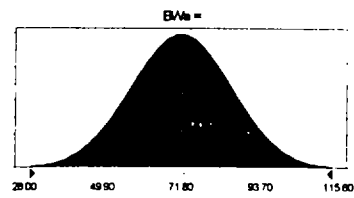
Assumption: BWa =

Cell: C17

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



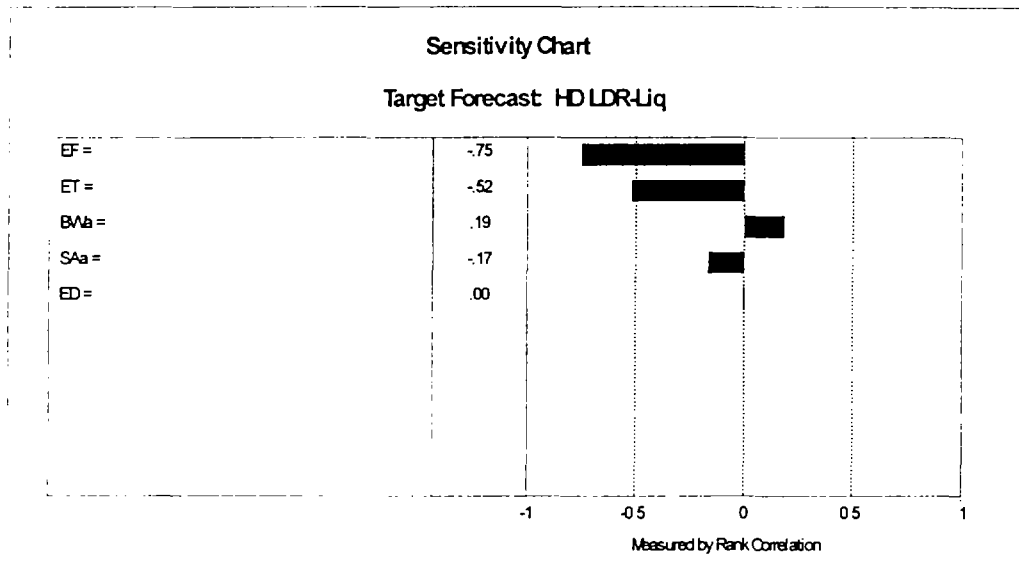
End of Assumptions

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### Crystal Ball Report

Simulation started on 2/10/99 at 16:51:03

Simulation stopped on 2/10/99 at 16:51:38





Forecast: HD LDR-Liq

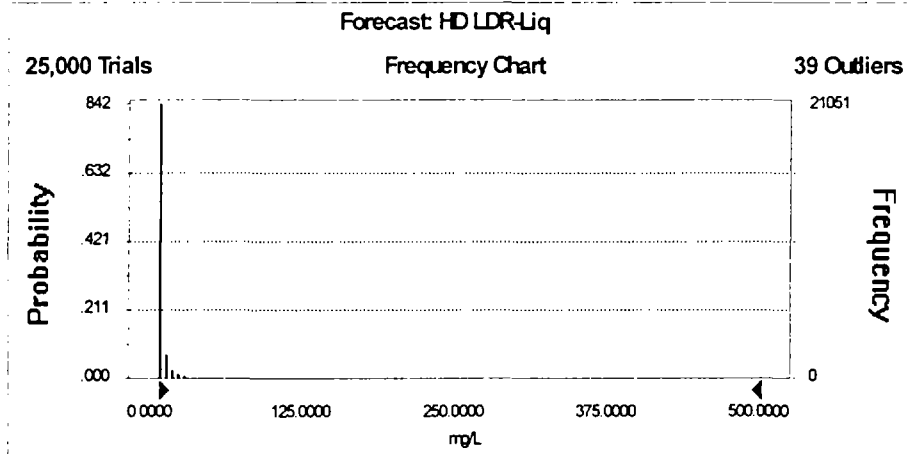
Cell: C23

Summary:

Display Range is from 0.0000 to 350.0000 mg/L  
 Entire Range is from 0.0686 to 8757.5500 mg/L  
 After 25,000 Trials, the Std. Error of the Mean is 0.7175

Statistics:

	<u>Value</u>
Trials	25000
Mean	7.9905
Median	1.4475
Mode	---
Standard Deviation	113.4481
Variance	12870.4646
Skewness	52.23
Kurtosis	3,251.96
Coeff. of Variability	14.20
Range Minimum	0.0686
Range Maximum	8757.5500
Range Width	8757.4813
Mean Std. Error	0.7175



Forecast: HD LDR-Liq (cont'd)

Cell: C23

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	0.0686
5%	0.4009
10%	0.5046
15%	0.5981
20%	0.6886
25%	0.7895
30%	0.8931
35%	1.0102
40%	1.1409
45%	1.2830
50%	1.4475
55%	1.6340
60%	1.8813
65%	2.1780
70%	2.5835
75%	3.1124
80%	3.9228
85%	5.2627
90%	7.9517
95%	16.0540
100%	8757.5500

End of Forecast

### Assumptions

**Assumption: ET =**

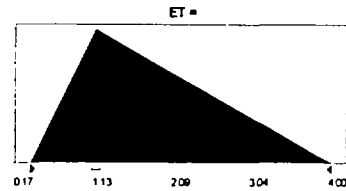
**Cell: C7**

Triangular distribution with parameters:

Minimum	0.17
Likeliest	1.00
Maximum	4.00

Selected range is from 0.17 to 4.00

Mean value in simulation was 1.72



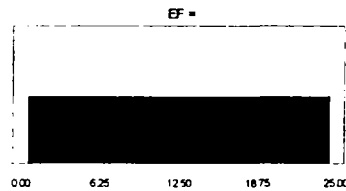
**Assumption: EF =**

**Cell: C8**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



**Assumption: ED =**

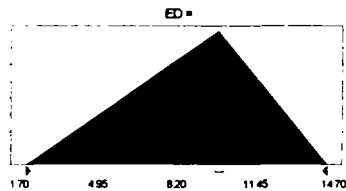
**Cell: C9**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80



**Assumption: SAa =**

**Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.66



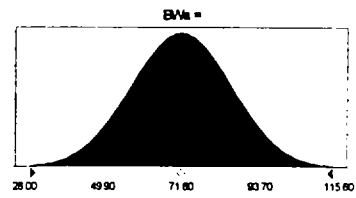
Assumption: BWa =

Cell: C13

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



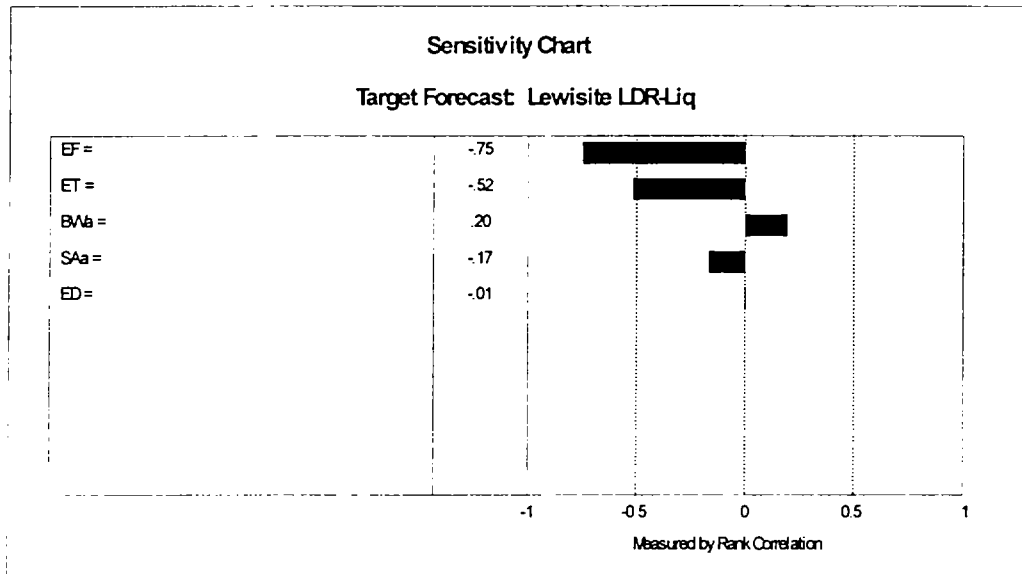
End of Assumptions

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### Crystal Ball Report

Simulation started on 2/10/99 at 16:42:25

Simulation stopped on 2/10/99 at 16:42:58



Forecast: GA LDR-Liq

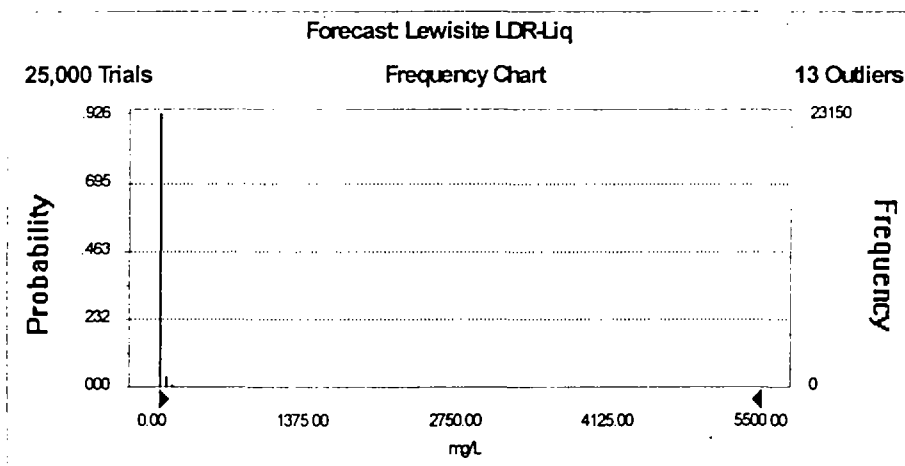
Cell: C23

Summary:

Display Range is from 0.00 to 11000.00 mg/L  
 Entire Range is from 1.38 to 437201.37 mg/L  
 After 25,000 Trials, the Std. Error of the Mean is 26.06

Statistics:

	<u>Value</u>
Trials	25000
Mean	247.81
Median	43.50
Mode	---
Standard Deviation	4120.86
Variance	16981466.06
Skewness	68.99
Kurtosis	6,081.61
Coeff. of Variability	16.63
Range Minimum	1.38
Range Maximum	437201.37
Range Width	437199.99
Mean Std. Error	26.06



Forecast: GA LDR-Liq (cont'd)

Cell: C23

Percentiles:

<u>Percentile</u>	<u>mg/L</u>
0%	1.38
5%	12.05
10%	15.17
15%	17.95
20%	20.78
25%	23.69
30%	26.73
35%	30.17
40%	33.96
45%	38.48
50%	43.50
55%	49.29
60%	56.47
65%	65.77
70%	78.09
75%	93.92
80%	118.05
85%	156.25
90%	235.30
95%	470.25
100%	437201.37

End of Forecast



### Assumptions

**Assumption: ET =**

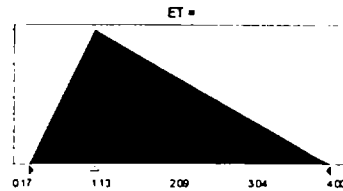
**Cell: C7**

Triangular distribution with parameters:

Minimum	0.17
Likeliest	1.00
Maximum	4.00

Selected range is from 0.17 to 4.00

Mean value in simulation was 1.72



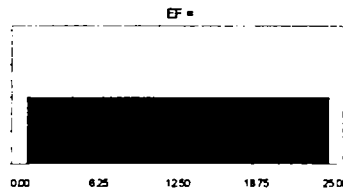
**Assumption: EF =**

**Cell: C8**

Uniform distribution with parameters:

Minimum	0.00
Maximum	25.00

Mean value in simulation was 12.50



**Assumption: ED =**

**Cell: C9**

Triangular distribution with parameters:

Minimum	1.70
Likeliest	10.00
Maximum	14.70

Selected range is from 1.70 to 14.70

Mean value in simulation was 8.80



**Assumption: SAa =**

**Cell: C12**

Triangular distribution with parameters:

Minimum	2,441.00
Likeliest	3,420.00
Maximum	5,700.00

Selected range is from 2,441.00 to 5,700.00

Mean value in simulation was 3,853.68



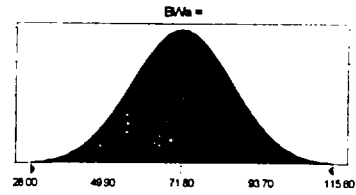
Assumption: BWa =

Cell: C13

Normal distribution with parameters:

Mean	71.80
Standard Dev.	14.60

Selected range is from -Infinity to +Infinity  
Mean value in simulation was 71.80



End of Assumptions

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